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FINAL TECHNICAL REPORT

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Cosmogenic ^{14}C in Antarctic and non-Antarctic meteorites and lunar samples.

SUMMARY

a. Meteorite studies

This grant enabled us to develop measurements of ^{14}C in meteorites as a useful tool for estimates of terrestrial age. Prior to the inception of this grant, only a few measurements of ^{14}C terrestrial ages had been made. Sample sizes were larger, and there had been no systematic study of the various parameters affecting production of ^{14}C, such as depth dependence, and the production cross sections for ^{14}C from spallation amounted to a few data points. ^{14}C ages are now an accepted terrestrial age estimate in the meteorite community, whereas before this work the few data available were difficult to interpret.

We have obtained terrestrial ages not only on groups of meteorites from different geographic areas (e.g. Jull et al., 1993) but also information on unique meteorites from particularly interesting groups, such as meteorites originating from the Moon, or SNC meteorites, which many researchers believe are derived from Mars.

Our research has allowed us to develop systematic studies of the ^{14}C ages of Antarctic meteorites, to determine the terrestrial-age distribution of meteorites from sites where most meteorites collected in the last 40,000 years; the terrestrial-age distribution of meteorite falls from arid and semi-arid regions, such as Roosevelt County (New Mexico), northwest Texas, Western Australia and North Africa. In one case, the terrestrial age of a meteorite (ALH 82102) found emerging from the Antarctic ice was dated at about 11,000 yr and gives us an estimate of the age of the ice ablating from this part of the Far Western Icefield

Another important series of measurements has been stable-isotopic and ^{14}C studies of weathering products in meteorites. Weathering has become an important topic in recent years to meteoritics, because weathering affects the composition of meteorites stored for long times in deserts or in Antarctica. A measurement of the ^{14}C composition of the large deposits of weathering products on an Antarctic meteorite, LEW 85320, confirmed that these materials can develop rapidly (Jull et al. 1988). Our understanding of these effects is important when comparing these meteorites to relatively-pristine recent falls. Also, there is the possibility of potential extraterrestrial weathering of SNC meteorites (e.g. Jull et al, 1992).

b. Lunar Sample Studies

We have studied the ^{14}C depth-dependence in Apollo 15 lunar soil cores, and in the lunar rock 68815 (Jull et al., 1991, 1992) . These results have given us a better understanding of the production of ^{14}C by solar (SCR) and galactic (GCR) cosmic rays. The profiles in 68815 show solar-cosmic-ray production of ^{14}C at levels of about 17dpm/kg, and typical galactic-cosmic-ray production. The SCR flux calculated is similar to that found for other radionuclides, and ^{14}C in cores. These measurements also drove us to obtain new and better cross sections (e.g. Sisterson et al., 1992, 1993) to understand our results. These results have been compared to the SCR and GCR flux estimates of other radionuclides, and there is now quite good agreement. Thus, we can now state more clearly that there is little evidence for major changes in SCR flux over time scales of thousands to millions of years.

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